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PROCEDURE FOR INSECT PREVENTION AND CONTROL IN
PLANTS PROCESSING NONFAT DRY MILK SOLIDS

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Stored-Product Insects Section



Insect infestation in stored nonfat dry milk solids can become a serious and expensive problem. Every effort is being made to provide safe storage, and attention is being given to a program of insect prevention and control in warehouses. The infestation in stored dry milk can originate, however, in the drying plant. Therefore proper insect prevention and control are necessary in the plant to provide a clean and wholesome food product that will meet the standards of industry, the Department of Agriculture, and the Food and Drug Administration.

The procedures outlined here are suggested as a guide to help drying plants prevent the occurrence of insects. Much of the program would apply equally as well to any food-processing plant, but points of special interest to milk-drying plants are included. The procedures are based on what is considered to be the best information available at the present time, but the Department of Agriculture does not assume responsibility for the effectiveness of the program or for any resultant effects.

I. Kinds of Insects Involved.

1. One of the most important pests of dry milk at present is a small insect with the scientific name of Trogoderma versicolor. It has been given the common name "larger cabinet beetle" because it sometimes gets into cabinets of insect collections and damages the specimens. It is sometimes called a carpet beetle because it is in the same family, Dermestidae, with the carpet beetles. We will refer to it as Trogoderma, since it is not a carpet beetle and the name "cabinet beetle" is not particularly appropriate when it is a pest of dry milk.

Trogoderma passes through the four usual stages of insect development, egg, larva, pupa, and adult. In warm weather the eggs hatch in one to two weeks. The larvae are very small when they first hatch. As they feed and grow larger they shed their skins a number of times. They are brownish, fuzzy, and about $1/4$ inch long when full grown. The larval period lasts about three to six months under favorable

conditions. If temperatures are low, or if food is scarce or unsatisfactory, larval development may require a year or more. When the larvae are full grown they transform into the pupal or resting stage which lasts two or three weeks. When the adult beetles emerge they live for two to four weeks. The females usually lay 50 to 100 eggs. The adult beetles are about 1/8 to 3/16 inch long, shaped somewhat like a small ladybird beetle, and are blackish, mottled with brown.

The larval stage is the one most often found because this is the active feeding stage and because the insect spends the greatest part of its life as a larva.

2. Several other stored-product insects may get into dry milk. These include such pests as the black carpet beetle, flour beetles, "weevils", and moths.
3. Other insects such as roaches, flies, ants, and silverfish, which sometimes are pests in food-processing plants, may occur in drying plants, and can also get into the product.
4. It is important to know what kind of insect is involved in an infestation in order to know how best to deal with the problem. If you are not sure of the identity of troublesome insects, collect some specimens, place them in a small vial full of rubbing alcohol, and send them to your state entomologist, extension entomologist, county agricultural agent, or the Entomology Research Branch of the U. S. Department of Agriculture, Washington 25, D. C. Be sure your name and address are with the package that is sent so it can be identified with your letter of transmittal. You should tell where the insects were found, describe any damage they caused, and give any other observations you think may be pertinent. Publications on the control of common insects can also be obtained from most of the above sources. Many of the publications may be written primarily from the standpoint of control in the home, but the control methods and basic principles will be the same. You can make slight modifications to conform to the general requirements and conditions in your plant.

II. Plant Sanitation and Operations in Relation to Insect Prevention.

1. PROPER SANITATION IS THE MOST IMPORTANT MEANS OF PREVENTING INSECT TROUBLE IN A FOOD PLANT. Sanitation and good housekeeping should receive constant attention both inside and outside the plant. The program should be based on the idea of prevention rather than control. First, keep insects out, then by thorough cleaning remove any insects and material upon which they might feed so they will be starved out. When insecticides are used they will control insects more effectively in clean premises. The best of insecticides cannot

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overcome filthy and insanitary conditions. It is not possible to discuss here all the measures required to keep a plant scrupulously clean. Each plant presents individual problems and special circumstances that must be dealt with. A few important points will be mentioned here, as well as some others that might easily be overlooked.

Remember also that there will be a tendency to form an opinion about the purity and wholesomeness of your food product on the basis of the appearance of your plant. Plant inspection is usually a necessary prerequisite to purchase contracts. By law, the Food and Drug Administration is empowered to seize a food product that has been processed or handled under circumstances whereby it may have become contaminated, even though no contamination is detected in the product.

2. Designate one certain individual in each plant as the plant sanitarian responsible for sanitation and insect prevention, even though professional sanitation or pest control services are used. Give this individual proper authority and provide him with adequate equipment to accomplish the desired objectives. In some places the sanitarian is responsible directly to the plant superintendent. Give the sanitarian additional training if he needs it.
3. Use a heavy-duty industrial vacuum cleaner. This is an essential piece of equipment in a milk-drying plant. Set up a regular schedule for vacuuming the entire plant thoroughly every two months. Clean storage areas and less-used parts of the plant as well as processing, grinding, sifting, and packing rooms. Under some conditions the entire plant, or perhaps only certain areas, may need vacuuming more often than every two months.

Dust from grinding, sifting, and packing operations is one of the major causes of insect trouble in the drying plant. The problem is not confined to the immediate area where these operations go on, because the fine milk powder drifts all through the plant. It settles into cracks in floors and walls, on top of beams, on ledges, above window and door frames, and even in electrical fuse and switch boxes. The two-month vacuuming schedule will prevent the accumulation of powder for the period of time necessary for Trogoderma to complete a life cycle and multiply. Insects that may have become established in the powder will also be removed.

Be sure to dispose of the material picked up by vacuum cleaners and dust traps on exhaust fans. Otherwise it will only serve as an additional source of infestation.

4. Provide adequate exhaust fans equipped with dust traps for grinding, sifting, and packing rooms, and for any other plant areas where dust occurs. Install dust traps on exhaust fans not already so equipped. The exhaust fans are necessary to get the dust out of your plant.

The dust traps are necessary to keep from annoying your neighbors and to prevent an accumulation of dust around the outside of your plant where it would serve as food for insects and provide a source of infestation.

5. Store empty containers, liners, supplies, and finished product in a separate building or in rooms well removed from processing or packing operations. Keep any of the finished product in temporary storage separate from other materials. Keep storage areas clean, dry, and free from insects. Keep the reserve supply of empty containers closed. Protect containers and liners from contamination with dust, dirt, and insects. The insects that might crawl into your reserve supply of containers and liners will be in your product when it is packed.

Stack containers, liners, and finished product on movable platforms or skids at least 9 inches from the floor and 18 inches from the wall to permit cleaning, inspection, and spraying.

6. Each day take only the immediate daily requirement of containers and liners into the packing room. Be sure containers and liners are clean and insect-free before they are filled. Keep racks, cabinets, or platforms for the daily supply of liners and containers clean, dry, and free of insects. If insects are present here they can crawl into the containers and be waiting to infest the product as soon as it is packed.
7. Inspect liners and containers when received to be sure they are insect-free. If they are infested or if they become infested in your plant, have them fumigated with methyl bromide. There are several ways this may be done and the dosage and time of exposure will be governed by the method employed. Some pest control firms will be able to provide this service. Fumigation must be done only by those qualified by experience to handle the work.

After fumigation, clean the containers and liners before use by vacuuming or brushing thoroughly to remove dead insects.

Do not reuse containers or liners unless they are cleaned thoroughly and fumigated as discussed above for infested containers and liners.

8. Clean, scrub, and flush processing areas if possible with hot water or live steam at least once a day. Thoroughly clean the inside and outside of conveyors, chutes, grinders, sifters, hoppers, and packing equipment once a week. Pay special attention to dead-end spaces, ledges, or other places where the product accumulates. If insects are allowed to develop here, such spaces provide a constant supply of eggs or insects, or both, to infest the product and go right into the containers with the product when it is packed.
9. Empty garbage, refuse, and trash at the end of each day's operations. Dispose of it properly and clean the containers.

10. Keep locker rooms and lockers clean. Insects may be brought into the plant with clothing or lunches. Food scraps, empty beverage and milk bottles, or other materials left lying around will attract insects and supply food for their development. Then the insects will migrate to other parts of the plant.
11. Keep tool and equipment rooms clean. While they may appear to offer no insect problem, they may be an undisclosed source of infestation.
12. Clean thoroughly and spray railway cars and trucks for outgoing shipments of the finished product, to reduce the hazard of insect infestation in transit.

III. Use of Insecticides for Insect Prevention and Control.

1. Use a $\frac{1}{2}$ -percent lindane residual spray as a general-purpose insecticide. Apply it on a regular 2-month schedule, immediately following the routine scheduled vacuum cleaning of the plant.
 - a. Prepare a $\frac{1}{2}$ -percent lindane spray by mixing 13 ounces of a 25-percent lindane wettable powder with each 5 gallons of water. This wettable powder spray will cause some spotting, but is the most effective type of spray on absorptive or porous surfaces. Where spotting must be avoided or where painted or glazed non-absorptive surfaces are to be treated, a spray may be made from a liquid emulsifiable concentrate of lindane. Dilute the concentrate with water, according to the manufacturers' directions, to make a spray containing $\frac{1}{2}$ percent of lindane.
 - b. Apply the lindane spray in all sections of the plant, including storage areas, but restrict the application to those places or surfaces where insects hide or crawl, such as cracks, corners, edges of floors and lower parts of walls, floors under storage platforms, and protected places underneath and behind things.
 - c. Use spray equipment and nozzles that will produce a coarse spray with a minimum of drifting mist that could cause contamination. Protect the product, equipment, utensils, work surfaces, containers, and liners, against spray drift during application and do not spray on or into any of those things.
 - d. In unheated parts of plants in cool or cold sections of the country, two spray applications a year may be sufficient, usually about April 1 and August 1. In heated parts of the plant or in warmer sections of the country, intermediate treatments between the regular 2-month applications may be required in limited spots if such insects as roaches or ants are a problem.
 - e. A lindane residual spray is effective against a wide range of different kinds of insects. It is selected for routine application because it is more effective than some other insecticides against the Trogoderma beetle larvae that are currently causing a serious problem. Lindane is safe to use in processing, packing, and storage rooms when applied as prescribed.

2. Insecticides are a valuable supplement to sanitation for insect prevention and control, but under no conditions should they be considered as a substitute for sanitation.
3. Insecticide application in a food plant must be made only by an experienced and trained individual with a knowledge of proper methods, or under the direct supervision of such an individual. Hire a reputable pest control operator if you do not have a qualified employee at your plant.
4. It is impossible to give in a short space complete information on the use of insecticides for all the conditions and species of insects that might occur in drying plants. There are many kinds of insecticides, types of formulations, and kinds of application equipment available on the market. Be sure to select the right insecticide, proper formulation, and suitable equipment for the specific job to be done. When you buy insecticides, examine the ingredient statement on the label to determine the amount and kind of active ingredients. If you are not familiar with insecticides, obtain the advice of a reputable insecticide firm, pest control firm, or a State or Federal entomologist. The application of a cheap or ineffective insecticide, the use of the wrong material for a specific purpose, or the improper application of even the best of insecticides will not give satisfactory results, may contaminate the product or cause other injurious results, and will be a waste of time, effort, and money. Also remember that a food product must not contain either insects or insecticide.
5. There are a number of factors influencing the choice of the form in which an insecticide will be applied in a food plant. Some of these are as follows:
 - a. Residual sprays are extremely useful because the lasting effect of the insecticidal deposit not only controls an active infestation but provides continuing protection against reinestation. The application can be controlled carefully and restricted to just the places where insects hide, develop, or crawl. DDT or chlordane as well as lindane residual sprays may be useful for certain purposes.
 - b. Space sprays and aerosols will ordinarily be used in food plants for emergency treatments only, since they give only temporary results and do not usually get at the source of the trouble. Cover any exposed food, work surfaces, or open equipment during treatment to protect them from falling insects and settling spray mist. Synergized pyrethrum or allethrin are suitable materials for this method of application.
 - c. Insecticidal dusts are sometimes useful for blowing into cracks, spaces behind or underneath things, or other places difficult or impossible to reach with a liquid spray. They are preferable to sprays around electrical connections and wiring where a liquid would cause a short circuit. Dusts must be applied so they will

not drift to places where there should be no insecticide. In some places the appearance of a dust deposit is objectionable. Excessive moisture destroys the effectiveness of a dust deposit by causing it to cake or harden on the surface. Many kinds of insecticides can be applied as dusts.

- d. Fumigants are effective only in a tightly enclosed space or fumigation chamber where a high concentration of gas can be maintained for several hours. All fumigants are dangerous to man in the concentrations used for insect control and should be applied only by experienced operators.
- e. Some insecticides are dispensed as vapors, usually from an apparatus having an electrical heating unit. This method of dispensing insecticides must not be used in any part of the plant where the food product will be exposed to the vapor, even after the product is packaged unless the containers are metal and sealed.

6. Some precautions to observe in using insecticides are as follows:

- a. Have insecticides applied only by trained personnel or a reputable pest control firm.
- b. Do not apply insecticides directly to foods, utensils, equipment, work surfaces, containers, liners, or packaged products, and protect such things against drifting insecticide during application. Exercise particular care to insure that insecticides such as chlordane, DDT, and lindane are applied so no contamination will occur.
- c. Do not mix or store insecticides in processing, packing, or product-storage areas.
- d. Do not use oil-base insecticides in the presence of sparks or open flames, or on asphalt tile.
- e. Pull master switches before spraying liquid insecticides around electrical switches, fuse boxes, or cables where short circuits might result. Do not restore electrical current until spray has dried. Dust insecticides are preferable around electrical connections.
- f. In applying insecticides such as chlordane, DDT, or lindane, avoid unnecessary skin contact and breathing excessive amounts of spray mist or dust.
- g. After spraying or dusting is completed, empty the equipment and clean it to prevent rusting and corrosion. Safely dispose of the residue from the equipment.
- h. Store insecticides in a safe place.

IV. Inspection in Relation to Insect Prevention.

- 1. Constant vigilance for insect infestation is just as important as everyday sanitation and is a primary responsibility of the plant sanitarian. A follow-up inspection after special or routine cleaning operations and insecticide applications is essential to determine the effectiveness and to learn whether further action is required.

2. Inspect every place inside the plant and outside around the premises. The following list includes some critical areas and spots that are sometimes overlooked: walls, floors, cracks, openings, corners, within loose partitions, above false ceilings, behind wall panels and baseboards or molding strips, on top of beams and ledges, on windowsills, above window and door frames and behind loose ones, equipment (inside, on top, and underneath), product conveyors and chutes, electrical fuse and switch boxes (inside, behind, and on top), in and around storage bins and refuse bins or containers, supply rooms, tool and equipment rooms, processing and packing areas, locker rooms and lockers, desks in administrative and checkers' offices, storage and holding areas, under storage platforms, in reserve supplies of containers and liners, around and under loading docks and platforms, and in the dust traps on exhaust fans.
3. Look for live or dead insects, or signs of insect activity. Some hidden insects can be detected by finding their cast skins, droppings, or excrement stains near their hiding places. Some insects will leave trails in dust accumulations.

In inspecting nonfat dry milk solids, look primarily for the brown, fuzzy larvae of the Trogoderma beetles, and for their light, fluffy, empty cast skins. Since the larvae live several months to a year or more and shed their skins a number of times, there are likely to be many more cast skins than larvae present if the product has been infested very long. The cast skins will usually be on the surface, and the larvae on or near the surface. The larvae may also be between the layers of a multiple liner or between the liner and the container. The larvae of moths that infest dry milk spin a ropy webbing to which particles of milk powder adhere. The webbing may be found by running a spatula or some other instrument through the top few inches of powder and pulling to the surface, or by taking a sample from the top few inches of powder and sifting it through a screen.

Some insects such as roaches and silverfish tend to hide during the day and be active at night. You can often find them by quietly entering a dark room and shining the beam from a flashlight around the room, or by suddenly snapping on the lights. The daytime hiding places can be located by watching where the insects run for cover.

4. Two useful tools for inspection are a flashlight and an ice pick or a screwdriver with a long, slender blade. A hand lens is helpful but not necessary. The flashlight helps to see behind and underneath things, in dark corners, and into cracks and openings. The ice pick or screwdriver is used to stir, scratch, and probe into protected places.

V. Plant Construction in Relation to Insect Prevention.

1. Modern, tight concrete or brick construction is desirable because it provides for easy cleaning, prevention of accumulations of milk powder, elimination of insect hiding places, and fumigation when necessary.
2. In old plants certain beneficial improvements should be made where possible and if economically feasible.
 - a. Eliminate false floors, walls, and ceilings, and dead spaces under equipment. They can accumulate large quantities of milk powder in which insects develop, concealed and protected, to spread out into the plant or infest your product.
 - b. Fill cracks or holes in floors and walls, and around posts and supports. Renovate old or badly worn floors, or overlay with a suitable material.
 - c. Remove mopboards and fill any openings where walls and floors meet.
 - d. Paint walls or face them with tile for easy cleaning.
 - e. Close up any unnecessary openings to keep insects out.
 - f. Provide tight-fitting screens for windows and doors, with not less than 16 meshes per inch. Keep screens repaired. Have self-closing devices on screen doors at all entrances. Do not prop doors open. Fit doors with metal bumper plates for protection against hand carts and kicking.
 - g. Construct storage bins so workmen can clean in and around them quickly and easily. Have enough cleanout doors in wooden bins so the entire unit can be cleaned thoroughly.
 - h. Construct conveyors and chutes so there are no ledges or dead spaces, and so they can be cleaned thoroughly.
 - i. Construct loading docks and platforms so waste materials cannot accumulate under or around them.

VI. Keep Proper Records.

1. Good records are necessary for sound management. They will also provide a history of your sanitation and insect-prevention operations that can be extremely useful for answering certain questions that may arise.
2. Here are some records you should keep:
 - a. Date and areas covered in vacuuming, cleaning, insecticide application, and special inspections.
 - b. For insecticide applications: kind and source of insecticide, how applied, and how much used.
 - c. Date, kind, analysis, amount, and source of insecticide purchases.
 - d. Date and nature of corrective measures or remedial construction.



